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University of Maine

# Maine Agricultural Experiment Station

ORONO

BULLETIN 323 APRIL, 1925

## POTATO APHIDS

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BULLETIN 323

# POTATO APHIDS.[1]

EDITH M. PATCH.

## INTRODUCTION

The role of aphids as carriers of certain degeneration diseases of plants emphasizes the need of explicit attention to the habits of the species concerned. It serves a double convenience to have such material organized with particular reference to plant relationships. In accordance with that plan this paper is concerned only with those aphids that have been reported to infest the potato and other plants belonging to the same family.

Only two species of aphids of world-wide distribution are at present known which commonly attack the potato plant in numbers sufficient to cause serious injury directly due to their feeding operations. These are the "potato aphid" (*Macrosiphum solanifolii* Ashmead) and the "green peach aphid" or "spinach aphid" (*Myzus persicae* Sulzer). A third species, apparently also of world-wide distribution, is often present on the potato, frequenting especially the underside of the lower leaves. This is the "buckthorn aphid" (*Aphis abbreviata* Patch); which may, under certain conditions, sometimes cause infestations of a serious nature. All three of these species have been proved to be capable of spreading certain potato diseases under experimental conditions; and there can be no logical doubt that they function in the same way in the field. Wherever potatoes are grown for seed purposes these three species of aphids may need to be reckoned with.

Besides the danger of aphid-spread disease in the field, there is another time in the annual history of seed potatoes when they are susceptible to the same sort of damage. Stored potatoes often sprout before the time of planting. Under certain conditions such sprouts may become heavily infested with aphids and potato diseases may be spread during the time of storage. Such an occurrence would not be possible in the far north; both be-

[1]Papers from the Maine Agricultural Experiment Station: Entomology No. 117.

cause the aphids in cold climates do not carry over the winter except in the egg stage (the viviparous females dying off), and because of the housing conditions necessary to protect the potatoes from freezing. As seed potatoes are ordinarily handled in Maine, for instance, this danger point is eliminated from the situation. Farther south, however, in the United States, in France, in England, and in kindred climates the seed potatoes are in danger of infestation of and infection by aphids; and especial precautions need to be taken.

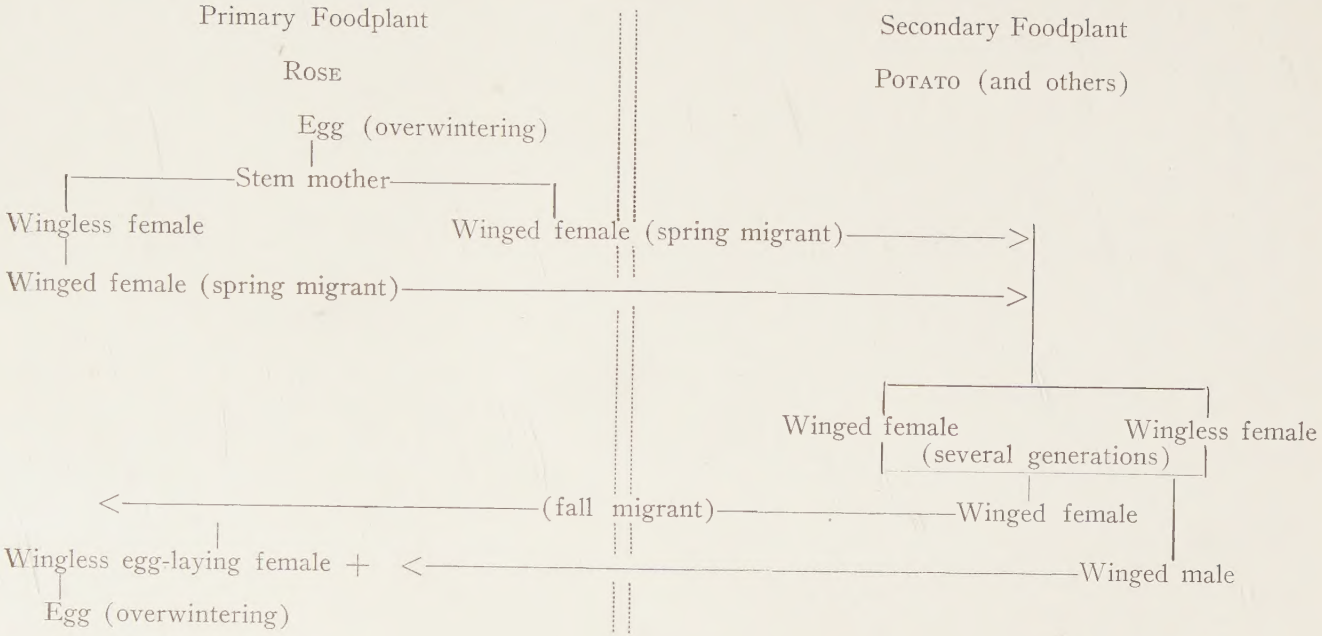
There are other species of wide distribution besides the "potato aphid," the "green peach aphid" or "spinach aphid," and the "buckthorn aphid" which are found breeding on potatoes occasionally in insignificant numbers; and local occurrences of considerable infestations are sometimes reported. But up to the present time these few species are the only aphids which ordinarily concern the fortunes of the potato grower. On this account they are the only ones given detailed attention in this bulletin. Readers interested in a summary of what might be termed aphids of minor importance to the potato and other plants of the nightshade family are referred to the key to the species on page 24, and to the list of recorded aphids on page 25.

## THE POTATO APHID

### *Macrosiphum solanifolii* (Ashmead)

This species is the largest of the aphids feeding on potato. It is subject to pronounced color variation, being either green or pink; and to those marked differences in structure, common among aphids—some individuals being winged and others wingless. It is rather a restless species and the wingless forms are somewhat inclined to drop from the plant when disturbed. The abdomen is not marked with dark, but is ordinarily clear in color either pink or green, though sometimes individuals may be found with a mottling, part pink and part green; and sometimes yellowish specimens are found. The mature forms are often rather glistening, but in the younger stages at least, the insect usually has a median line of dark green or pink (according to the color of the individual) while the rest of the body is paler by virtue of a very slight powdery deposit. This appearance is more noticeable in bright light.

Life Cycle of *Macrosiphum solanifolii*



The beak is short, usually not reaching the base of the second pair of legs, though certain collections have been taken with beaks a little longer. The cornicles are characterized by reticulations at the tip, as shown in figure 2. This reticulation holds true for all the mature individuals,—winged and wingless viviparous females, oviparous females, and males,—whether of the green or pink variety, and regardless of the foodplant upon which they have developed. The cornicles of the immature individuals are not so marked. The antennae of the wingless females are a little swollen at the proximal part of the third segment where a few sensoria are placed; those of the winged females have the sensoria in a single (sometimes slightly irregular) row extending nearly to the distal top of the third segment. The wing veins are clear cut and well defined though slender.

There is no structural difference between the spring and the fall individuals great enough to lead one to think they might be different species; though there is a range in size, influenced by foodplant or other conditions, great enough to cause hesitation in determining certain collections unless the progenitors are known. On account of the variation in size exact measurements are of little value, as they are as likely as not to be misleading. In some collections, more commonly late in the season, the antennae and cornicles may become very dark (though not the jet black of *M. rosae*), for nearly their entire length. This is in contrast with the paler antennae and cornicles which are more generally characteristic of the species and to this difference is to be traced some confusion in determining material. Poor mounts of mature individuals which have just molted sometimes do not show the reticulations of the cornicle tip and improperly prepared material is thus another cause of part of the synonymy of this species.

This species is distributed through entomological literature and collections under many names. It would be futile to guess at the number of synonyms that might already be charged to its account. It is not too much to hope that as the insect becomes better known on its different foodplants, all but one of its names may be shed like its molted skins. In this connection attention is called to the note under *M. cucurbitae* and *M. solani* on page 26 and 28 of this bulletin.

More detailed and technical descriptions have been published for *Macrosiphum solanifolii* but these comments together with

the accompanying figures should suffice to indicate the species when taken on potato or members of the same family.

## Life Cycle

The rose is, in the north, the normal overwintering host for the pink and green aphid of the potato; and the plant on which its spring colonies thrive. The first forms to appear each year are wingless females which hatch from black glistening eggs that were laid on the rose the fall before and that have overwintered on them. The eggs hatch at a time when the spring growth of the rose is tender and juicy and the young aphids have suitable feeding conditions. Because these first wingless females are the progenitors of all the succeeding generations for the season, they are called the "stem mothers." The stem mothers are the only generation that hatch from eggs. When they become full grown, they begin to bring forth living young and continue to produce in this way for about two weeks.

The progeny of the stem mothers are either pink or green. Part of them develop wings and part are wingless forms. The winged individuals of the second rose generation are the earliest of the "spring migrants;" and after they become mature, they no longer feed upon the rose but take flight to some plant suitable for their summer colonies—such a plant being called the secondary or summer foodplant. For this purpose there seems to be nothing in any part of the country they prefer to some member of the Nightshade Family. In the chief potato areas of Maine, wild members of this family are not abundant. Of the cultivated members, we find occasionally a few rows of tobacco evidently grown for home consumption, what tomatoes are grown in home gardens, and vast expanses of potatoes. Nothing could suit the needs of this aphid better than to have the country stripped of its native vegetation and planted to a favorite food. The migrants after leaving the rose have not far to seek their summer fortunes in neighboring potato fields. In localities where wild relatives of the potato are found, these are also infested by this insect. Nor are its attentions confined to solanaceous plants for the migrants will accept and establish summer colonies on representatives for more than thirty plant families.

As has been indicated, only a part of the second rose generation becomes winged and deserts the rose bush. The wingless forms remain and bring forth their broods of young on the spring foodplant. These, the third rose generation, for the most part become winged when mature and constitute the later spring migrants, seeking the potato in the same way as the winged members of the second rose generation.

While living during the summer on the potato, the two color-varieties of females, either green or pink, bring forth their successive generations of young, both winged and wingless. The wingless ones do not stray far from the plant they grow up on although they move to different parts of the plant or to neighboring plants if the one they are on becomes overcrowded with their colonies. The winged summer forms disperse over the potato field; and, if they have been feeding on plants sick with mosaic or leafroll (and perhaps other diseases), take the contamination with them and inject it into the tissue of such healthy plants as they may chance to feed on.

During the late summer and early fall, there develop on the potato winged individuals that differ from all the previous winged forms of the season in that, after acquiring wings, they have no further interest in the summer foodplant. These are the "fall migrants" and their flight, as their name indicates, takes them to the rose—the primary foodplant of the species and that upon which the overwintering eggs are to be deposited.

It is not, however, the return migrants that deposit the eggs; for they, like all the previous generations of the season beginning with the stem mother, produce live and active young. These young develop into wingless females which represent the last generation of the season and as they produce eggs instead of living young, it will be seen that they are an important link in the economy of the species for upon them depends the production of overwintering eggs. The males which develop in fall generation are the only males which appear during the season, all the other generations being comprised of females only. They seek the egg-laying females on the rose, where mating takes place.

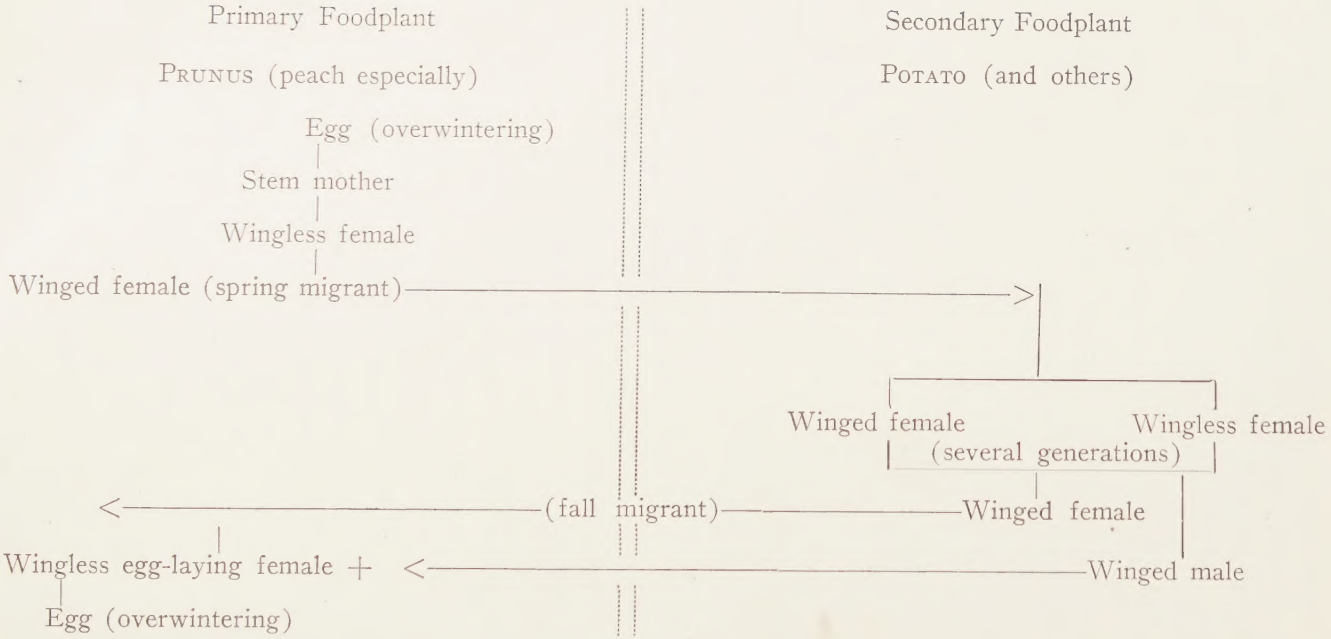
The eggs, which remain over winter on the rose, are those from which hatch the "stem mothers" or the first rose generation of the spring.

This process is repeated from year to year by the pink or green aphid—the fall generations, the overwintering egg and the spring generations living on the "primary host"; and the summer generations multiplying to great numbers on a "secondary host." And this is, in the main essentials, the manner of other related migratory aphids.

The primary foodplant of an aphid is the species of plant on which it habitually deposits its overwintering eggs and on which develops the spring generation of stem-mothers. It is usually the case that a migratory aphid uses some tree or woody shrub for the primary host even when living on herbs during the summer. Most aphids are confined to a single genus of plants for primary host purposes, or at most a few closely related genera; and some are restricted to a single species of plant.

It is not uncommon with some species of aphids to find fall migrants alighting on plants other than the true primary host and establishing colonies of egg-laying females on them. This is the case with *Macrosiphum solanifolii* the fall migrants of which, and their daughters (the oviparous females), are sometimes found on other plants than the rose. Strawberry, raspberry and apple are among the plants sometimes frequented by this species in the fall, the eggs being laid upon them. While it would be rash to state that the stem mothers never develop on these plants, it is safe to say in the north (as under Maine conditions) that if the spring forms ever do develop on anything but the rose it is of exceedingly rare occurrence. An aphid quest of over twenty years in this region has failed to locate spring colonies of this species except on the rose. An explanation of this circumstance that suggests itself is that the spring schedule of the rose, in the north, more nearly meets the needs of this species than other plants on which the eggs are sometimes laid. Spring colonies of this aphid have been reported on strawberry in New Jersey.

LIFE CYCLE OF *Myzus persicae*



## THE GREEN PEACH APHID OR SPINACH APHID.

*Myzus persicae* (Sulzer).

This species also has a broad and catholic botanic range and has a world-wide distribution. Its list of names is long and is still being added to. Confusion concerning this species in collections and literature is partly due to its size and color variations and partly due to structural variation in the different generations. The first and last generations in the cycle (the stem-mother and the egg-laying female) are pinkish wingless insects. The other wingless generations are yellowish green to whitish yellow in color and shiny throughout. Individuals of the winged generations have a dark head and thorax, and a green, brown or amber abdomen with conspicuous black markings. Winged females function as spring migrants, summer dispersal forms and fall migrants. Of these the spring migrant has its cornicle cylindrical in form while the summer and fall forms have the cornicles quite evidently swollen.

This difference in the shape of the cornicles has often led to confusion in determining the species. There have been published good technical and detailed descriptions of this aphid; but for the purpose of recognizing it when found on members of the Solanaceae, the key on page 24 and the accompanying figures will probably serve.

The life cycle is indicated in diagram form.

It has much the same summer career as the pink or green potato aphid, feeding on various herbaceous plants both wild and cultivated. In the fall, however, the winged forms desert these summer plants and seek the peach or plum tree where the egg-laying females are developed and the overwintering eggs are deposited in the fall, and where the spring forms are developed previous to the time for the migration to summer herbs. While the solanaceous plants are not more preferred by *Myzus persicae* than spinach and certain other vegetation, still the potato and related plants are tempting enough to this species so that they become very heavily infested in seasons of aphid abundance.

Its habits resemble those of *Macrosiphum solanifolii* in other than its wide food range. It, too, is somewhat haphazard about the destination of its fall generations and even the sex forms

occur and the eggs are laid on herbs and shrubs and trees not known to serve the spring generations adequately. Its true primary (overwintering) host is the peach and in America its greatest activities are in the peach zone. North of this area it is carried through on other species of *Prunus,* small and weak spring colonies being the rule. A feeble spring colony was taken on *Prunus nigra,* wild or Canada plum, near Caribou, Maine, June 27, 1924 by Mr. Reiner Bonde. It is also undoubtedly carried through on house and greenhouse plants by a succession of viviparous generations. When the climate is mild enough to admit, the viviparous generations are continued out doors; and in such localities the overwintering eggs play a much less vital part in its life history.

## THE BUCKTHORN APHID.

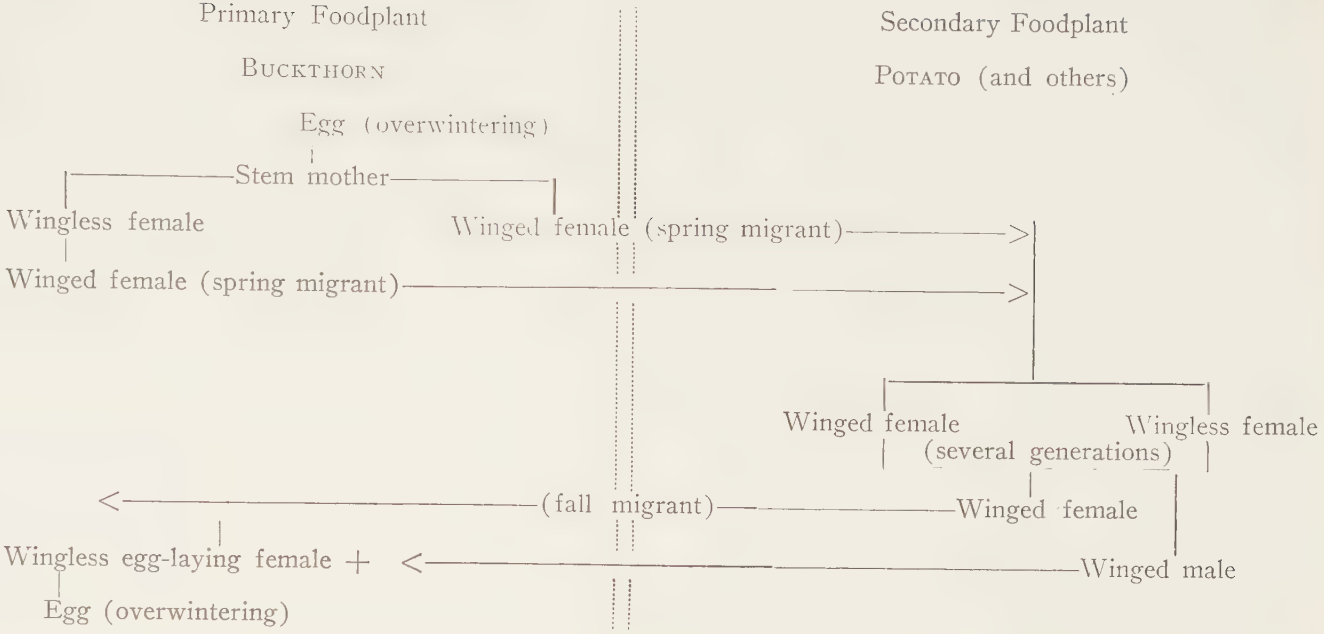
### *Aphis abbreviata* Patch.

The buckthorn aphid ranks third in its abundance on the potato and it lags far behind the two foregoing species. Under especial local conditions it may be present on potato in greater numbers than either of the other two as was the case with a plot under observation at Presque Isle, Maine in 1923; but this is unusual. The potato is far from being a favorite summer foodplant for this species which thrives better on cultivated nasturtium and certain other plants. It has been recorded from about thirty families of plants and as its range and habits become better known this list will doubtless be extended.

The fact that this insect seems to thrive best during the summer in shady or moist situations makes its habits on certain plants quite different from its behavior on others. Thus in some situations it will be found thickest on the exposed most rapidly growing part of the plant, and the terminal stem will be entirely covered with its colonies. In other places, as in a sun exposed potato field, this aphid seeks the under side of the leaves almost exclusively, especially the older lower leaves; and often those touching the ground will be found packed with these aphids when the stem and upper leaves are practically free.

It is not alone on the basis of direct feeding injury that the economic damage by aphids can be judged. They must also be reckoned with as possible carriers of plant diseases.

Life Cycle of *Aphis abbreviata*



The fact that two other species of aphids *(Macrosiphum solanifolii* and *Myzus persicae)* had been found, under experimental conditions, to transmit potato mosaic laid the buckthorn aphid open to suspicion in the same connection; and experiments conducted by Dr. Donald Folsom and Dr. E. S. Schultz proved this species also to be capable of transmission of mild mosaic in potatoes. Inasmuch as the former species have also been proved to be transmitters of other degeneration diseases, in addition to several types of mosaic, there is reason to expect proof eventually that the buckthorn aphid is a transmitter of more degeneration diseases than mosaic of the mild type.

As will be seen by looking at the diagram of the life cycle of this species, the buckthorn aphid overwinters on the buckthorn. *Rhamnus alnifolia* and *R. cathartica* are used for this purpose in Maine and quite likely other species of this genus where they occur. From buckthorn the spring winged forms migrate and to this plant the fall migrants return.

This is a much smaller species than the two previously discussed, the wingless females ranging from 1.3 mm to 2.15 mm in length of body. In general it may be said that the wingless forms vary through different shades of green and of yellow. The early spring forms on the buckthorn are green and those colonies summering on the buckthorn are green or yellowish green. On other summer foodplants, the wingless females are green, yellowish green, or yellow.

Late in the season, the last generation of wingless females to appear on the summer foodplants are found to have two distinct color characters. These are found in the same colonies. The individuals of one series are clear green with pale green young (nymphs) visible through the body wall of the abdomen. These pale green nymphs after birth develop into the winged females that function as fall migrants flying to the buckthorn there to give birth to the egg-laying generation. The individuals of the second series are very dark green, by far the darkest to appear at any time during the season. Their color is deepened by the dark color of the unborn young showing through the body wall. These nymphs with amber-colored head and very dark green abdomen are the young males that develop wings and fly back to the buckthorn in time to mate with the oviparous females.

The color distinction between these two series of fall females is very striking.

The oviparous females, developing on the buckthorn leaves, are yellow. The eggs which they deposit are first green, soon turning black.

All the wingless forms have pale antennae, cornicles and cauda. The legs are pale and the feet dark. In the older individuals the very tips of the cornicles and the distal portion of the antennae become dusky. The beak is pale with last segment dusky.

The winged forms, whether spring migrants, summer dispersal forms, fall migrants or males all, so far as the observations of the writer go, have green abdomens though those of the males are so dark a blue-green that as the individual ages, it appears nearly black. The head and thoracic lobes of the winged forms are black. The distal part of the antennae and the cornicles are dusky to near-black, but not jet black. The coxal segment and feet are dark, the tibial segment pale with dusky distal portion. The cauda and anal plate are dusky to dark. The wing-veins in both fore and hind wings are all well defined. There is a black spot on the abdomen at the base of the cornicle and 3 lateral black spots anterior to the cornicle.

## CONTROL MEASURES.

In years of great abundance, there is no doubt that the direct injury due to the work of aphids is a serious matter for the potato plant. At such times the colonies of the pink or green potato aphid practically cover the tips of the growing shoots and crowd thick upon the terminal leaves—parts of the plant particularly tender and therefore susceptible to injury. Though the individuals are small, they mass their colonies in great numbers, frequently thousands to a plant; and as they keep their beaks plunged into the plant tissue and suck sap almost constantly, this drain upon the vital juices of the plant must, in itself, be a severe tax. This species does not confine its attack to the terminal shoots and leaves; but colonizes the blossom clusters which wilt and wither under severe attack. Colonies also occur on the underside of the lower leaves. *Myzus persicae* attacks the same portions of the potato plant as *Macrosiphum solanifolii*. *Aphis*

*abbreviata,* when on the potato, seems to confine its colonies more closely to the underside of the lower leaves than the other two species.

More insidious than the direct damage by aphids in feeding is the harm rendered in transferring disease from sick plants to well ones. For aphids, feeding as they do by plunging their beaks into the juices of the plant, are able to inoculate one plant with virus they have taken from another. Measures to control aphids need to be considered, especially in localities where seed potatoes are grown.

*Destruction of the overwintering hostplants.* It may seem a ruthless proceeding to kill out one type of vegetation for the sake of another, yet all sorts of weeding practices are means to just that end. If a man's fortunes are centered on the production of certified seed potatoes, why increase the expense and difficulty of the operation by planting a hedge of shrubs necessary to the life cycle of an aphid known to be a carrier of potato diseases? In most parts of the country it may be impractical to attempt the destruction of both rose bushes and buckthorn in the vicinity of seed potato fields; but there are localities, especially in the north, where this would probably be the simplest, least expensive, and most effective method of controlling *Macrosiphum solanifolii* and *Aphis abbreviata.* Salting the soil is one feasible way.

When it comes to a question of the destruction of peach trees for the sake of seed potatoes, the conflict of economic interests would make this obviously ridiculous. In certain localities, nature takes a regulating hand in the game of *Myzus persicae,* for this aphid is not so abundant north of the peach zone. A much reduced number of this species, however, manages to overwinter on other trees of the same genus *(Prunus);* and the localities where the destruction of bird cherries and choke cherries and wild plums is practicable, are probably scarce. An area where *Rosa, Rhamnus* and *Prunus* could all three be eliminated, would be far to seek, though, if found, it would be most desirable from the standpoint of aphid-free seed-potatoes.

*Treatment of overwintering hostplants.* By thorough spraying or dusting of rose, peach, and buckthorn, the fall and spring generations of the three species of potato aphids could be greatly reduced and thus lessen damage to potato. Local or community conditions would of course indicate whether such measures would

be desirable, feasible, or even possible. Under certain circumstances, this method might supplement a partial program of destruction of these plants.

*Treatment of potato plants.* Aphids inhabiting the upper and more exposed portions of the potato plant can be killed by contact sprays. Preparations of nicotine sulphate have been effectively used for this purpose. It is the aphids in such rapidly growing portions of the plants that appear to do most damage by direct feeding injury; and, during years of excessive aphid abundance, this might be economically worth the expense involved. However it should be borne in mind that *Aphis abbreviata* is confined mostly to the underside of the lower potato leaves, and that *Macrosiphum solanifolii* and *Myzus persicae* colonize the lower as well as the upper leaves. Where potato plants are large and sprawly it is not possible to spray the underside of the lower leaves. Aphids in such situations escape except in so far as they are overcome by the nicotine fumes. The problem of reaching these is more one of fumigation than contact. For purposes of fumigation, dusting operations are considered by many to be more effective than liquid sprays in killing aphids under the lower leaves.

*Roguing, entomologically considered.* It is becoming a common practice among growers of certified seed to cull out from their field the plants that show symptoms of certain diseases. This process is termed "roguing." Because the symptoms are not always evident before the aphids migrate to the potatoes it is sometimes difficult to complete "roguing" until after the plants become colonized by these insects. If aphids are present in the field, it would seem desirable to have the plants which are "rogued out" removed at once from the vicinity or treated so as to render them harmless, for if such plants are thrown down near the field, the aphids would leave the wilting vegetation for fresh plants and an enforced dispersal from diseased plants to well ones would occur, thus lessening the effectiveness of the roguing. If not removed at once it would seem desirable to dump the potato plants directly into old barrels where they could be crowded down and covered over with newspapers or sacks wet in kerosene.

*Factors bearing on control measures against potato aphids.* If it were certain that aphids are the only agents spreading mosaic, leafroll, or certain other potato diseases in the field, a very

considerable expense would be justified in aphid control in the interest of disease free seed potatoes. Until it is known to what extent other potato-frequenting insects function as carriers of plant disease, it is impossible to estimate definitely just how much emphasis on aphid control is economically justifiable either in the seed-potato field or in crops grown for the table market.

But the fact that there may be other insects guilty of the same offense is obviously no argument against a campaign directed toward aphids. That is, the possibility that a complete elimination of the spread of mosaic may not be attained is no reason for neglecting measures that promise to reduce such spread.

## KEY TO THE APHIDS OF THE NIGHTSHADE FAMILY.

### (The Potato and Related Plants)

1. Root aphids.....2
   Aphids on parts of plant above ground.....4
2. Last antennal segment with distal filament elongate.....*Aphis maidiradicis* Forbes
   Last antennal segment with not more than a short distal spur.....3
3. Cornicles on broad cones.....*Lachnus incertus* Schouteden
   Cornicles lacking. Antennal segment II.....*Geoica phaseoli* Passerini
   *Geoica radicicola* Essig
4. Aphids occurring in greenhouse.....5
   Aphids attacking sprouts of stored potatoes.....6
   Aphids occurring in the field.....8
5. Wingless female with conspicuous dark markings on abdomen (one horse-shoe-shaped mark).....*Myzus circumflexum* Buckton
   Wingless female with immaculate body.....6
6. A large species (pink or green) with cornicles having a distal area of reticulate markings.....*Macrosiphum solanifolii* Ashmead
   Cornicles with no reticulate area.....7
7. Antennal segment III of wingless female without sensoria.....*Myzus persicae* Sulzer
   III of wingless female with sensoria.
   Cornicles cylindrical.....*Myzus pseudosolani* Theobald
8. A large species (pink or green) with cornicles having a distal area of reticulate markings (See Fig. 2).
   .....*Macrosiphum solanifolii* Ashmead
   Cornicles with no reticulate area.....9

9. Wingless female not black; (or if black, not with "bushy" cauda)..10
Wingless female dull black. Cauda "bushy" (with 5 or more pairs of hairs).....*Aphis rumicis* Linn.
*Aphis solanella* Theobald
*Aphis solanophilus* Blanchard

10. Antennal tubercles prominent and converging (See Fig. 6).
.....*Myzus persicae* Sulzer
*Myzus pseudosolani* Theobald
Antennal tubercles shallow and diverging.....11

11. Wingless female with black cornicles (seldom abundant).....*Aphis gossypii* Glover
Wingless female with pale cornicles.....*Aphis abbreviata* Patch
*Aphis solanina* Passerini

## LIST OF APHIDS RECORDED ON PLANTS OF THE NIGHTSHADE FAMILY.

About 50 aphid names occur in literature as records of species taken on potato or other Solanaceae. Some of these names are synonyms; some refer to "lost" species; some indicate possibly incorrect determination; some record stray individuals found while resting during flight; some apply to species, which, though actually found feeding, are of infrequent occurrence on plants of this family and accept them only under unusual conditions; and some (a very small minority) are proper nightshade aphids. The comments accompanying the following list give the status of the respective names as at present understood by the compiler. Concerning many of the names it might be said that it is not important that they should have a continued connection with the literature of potato aphids; but a review of them may serve a helpful purpose.

*abbreviata* Patch, *Aphis*. Patch (1924). Also p. 18 to 21 of present bulletin. This is apparently the "*Aphis solanina* Passerini" of Theobald (1922), p. 10 and possibly the same as *Aphis frangulae* of Kaltenbach and Koch.

*amygdali* (Buckton), *Anuraphis*. Buckton (British Aphides, vol. II), p. 106. "I have taken the winged form on the tobacco plant, but the occurrence of a winged female on any plant does not prove that it was bred there."

*atropae* (Mordwilko), *Macrosiphum*. Mordwilko (1894). Perhaps a synonym of *Macrosiphum solanifolii?* On *Atropa belladonna*.

*avenae* (Fabricius), *Siphocoryne*. Recorded from *Nicotiana* by Das (1918), p. 272. This species has no vital connection with Solanaceae. It migrates between certain Rosaceae and Gramineae.

*bipapillata* Theobald, *Acaudus.* Theobald, 1923, p. 20. Described from a single wingless female taken from potato. Rose-shire, Scotland.

*carduinus* (Walker), *Myzus.* "Auf *Nicotiana tabacum.*" Cholodkovsky (1910), p. 145. *(Phorodon carduinus* Passerini). According to C. Borner this is a non-migratory species on *Cirsium.*

*circumflexus* (Buckton), *Myzus.* Reported from *Schizanthus* by Theobald (1913), p. 117. Reported from *Solanum* by Swain (1919), p. 174. A greenhouse species of world-wide distribution, indicated in key on p. 24 of present bulletin.

*cucumeris* Forbes, *Aphis.* On potato. Williams (1891), p. 21. This is one of the synonyms of *Aphis gossypii* Glover.

*cucurbitae* (Middleton), *Macrosiphum. Solanum melongena.* Mason (1921), p. 25. This name antedates that of *Macrosiphum solanifolii* Ashmead and undoubtedly refers to the same species. But until the synonomy of this aphid is finally worked out, there would be nothing gained, except further confusion, to shift from one unstable name to another.

*cucurbiti* Buckton, *Aphis.* See under *Aphis gossypii.*

*dianthi* (Schrank) *Myzus.* One of the synonyms of *Myzus persicae* Sulzer.

*euonymi* Fabricius, *Aphis.* Borner and Janisch (1922), p. 65-67. "In summer and early autmun it is found on *Solanum nigrum*——. It is not injurious." This is considered by Davidson (1914) to be a synonym of *Aphis rumicis.*

*frangulae* Kaltenbach, *Aphis.* This species has not (by this name) been recorded from members of the Solanaceae. If, however, the buckthorn aphid, *Aphis abbreviata,* should prove to be a synonym of this, the large list of foodplants recorded for *Aphis abbreviata* will, of course, need to be credited to *Aphis frangulae.*

*gossypii* Glover, *Aphis.* On account of its color and size variations, its wide geographical distribution, and the food habits recorded for it, this aphid has been much confused in collections and in literature. In the United States, certainly, and in other countries, probably, many of the activities ascribed to this species should be credited to *Aphis abbreviata.* The key on page 24 of this bulletin will serve to distinguish this species when taken on plants of the nightshade family where it sometimes establishes colonies, although these plants are not among its favorites. Van der Goot (1916), p. 93 gives *Aphis malvae* Koch and *Aphis cucurbiti* Buckton as synonyms of this species. He also suggests that *Aphis malvaccarum* van der Goot *(malvoides* Das) may be a synonym of *Aphis gossypii.*

*hyosciami* Kittel, *Aphis. Hyosciami niger.* Wilson-Vickery (1918), p. 255. This aphid was described in 1827, and (so far as the literature is concerned) is evidently a lost species.

*incertus* Schouteden, *Lachnus. (L. subterraneous* Del Guercio). This is reported from the roots of *Solanum lycopersicum.* Del Guercio (1907-1908), p. 279, Italy.

*lactucae* (Schrank), *Macrosiphum.* Theobald (1913), p. 55. *Solanum tuberosum.* This aphid has none but a chance association with plants of the nightshade family. It migrates between *Ribes* and *Lactuca,* (and certain other Compositae).

*latysiphon* Davidson, *Amphorophora.* Although this is indicated by Swain (1919), p. 54, as collected from potato, the records are not clear that its presence on members of this family is more than accidental.

*leguminosae* Theobald, *Aphis.* Recorded on *"?Solanum nigrum"* growing amongst beans by Theobald (1922-1923), p. 49. Egypt.

*lycopersicella* Theobald, *Macrosiphum.* Theobald (1914). On *Lycopersicum esculentum.* Africa.

*lycopersici* (Clarke), *Macrosiphum.* "A handsome insect found on tomato, generally on the blossoms which they destroy." Clarke (1903), p. 253. As *Macrosiphum solanifolii* is, in the estimation of the compiler of this list, the handsomest aphid found on tomato, the suggestion is made that this disputed species may be considered a synonym of *Macrosiphum solanifolii.* The type was lost.

*maidiradicis* Forbes, *Aphis.* The corn root aphid is reported by Vickery (1910), p. 104 to colonize the roots of *Solanum nigrum.*

*malvacearum* van der Goot, *Aphis (malvoides* Das). On *Solanum lycopersicum* and *Withania somniferum.* Das (1918), p. 151 and 273. This species is thought by van der Goot to be a small form of *Aphis gossypii.*

*malvae* Koch, *Aphis. On Withania somniferum.* Das (1918), p. 272. This species is usually conceded to be a synonym of *Aphis gossypii.*

*malvae* Walker, *Aphis.* Recorded on tobacco by Buckton (British Aphides vol. II), p. 43. The species figured by Buckton in plate 49 cannot be a variety of the species known as *Aphis gossypii.* It more closely resembles *Aphis abbreviata;* but the details are not sufficient to make sure a determination.

*malvoides* Das, *Aphis.* See *Aphis malvacearum.*

*nerii* Kaltenbach, *Aphis. Solanum betaceum* Cav. Passerini (1863), p. 339. What this aphid was I do not know. It would not seem to be the same as *Aphis nerii* Boyer.

*papaveris* Fabricius, *Aphis. Datura.* Kaltenbach (1874), p. 269; *Solanum nigrum* L. Ferrari (1872), p. 71. This name is considered a synonym of *Aphis rumicis* Linn. by J. Davidson (1921), p. 81. Borner and Janisch (1922) consider *Aphis papaveris* distinct and state that it refuses to feed on *Solanum nigrum.*

*papillata* Theobald, *Jacksonia.* Theobald (1923), p. 20. Described from a single wingless female and some young forms—taken under a potato leaf. Ross-shire, Scotland.

*pergandii* Sanderson, *Myzus. Solanum melongena* L. Sanderson (1901), p. 73. This is evidently a synonym of *Myzus persicae,* the forms taken having cornicles very slightly swollen.

*persicae* (Sulzer), *Myzus.* See p. 17 of present bulletin.

*phaseoli* (Passerini), *Geoica.* This root aphid has been found to attack the underground stems of potatoes and their roots. They prefer bean roots, however, and do not seem to be important as a potato pest. Theobald (1922), p. 11.

*pseudosolani* Theobald, *Myzus.* "Found so far only on potatoes, especially abundant on seed potatoes with *Myzus persicae* in many cases side by side, easily told by its pale cylindrical cornicles.....I have found it

from January to April on seed potatoes, and on the bine from August to October." Theobald (1922), p. 10. See also key, p. 24 of this bulletin.

*radicicola* (Essig), *Geoica.* Essig (1910). This American insect is close enough structurally to the European *Geoica phaseoli* to suggest that they may be the same. See also key on p. 24 of this bulletin.

*rosae* (Linne), *Macrosiphum.* Because *Macrosiphum solanifolii* is a rose aphid it has been often confused in collections and literature with that other large green or pink aphid which entomologists are agreed should properly be known as *Macrosiphum rosae.* Whenever "*Macrosiphum rosae*" is recorded on plants of the nightshade family, the reference should be interpreted as applying to the species at present designated as *Macrosiphum solanifolii.* Coret (1867) must almost certainly have had *Macrosiphum solanifolii* under observation when he stated that "aphids *(A. rosae)* from the roses cultivated in great numbers at Puteaux, take shelter during the winter in houses, etc., and that they there attack the buds on certain potatoes stored under cover to supply the markets of Paris in May." Two years later Coret (1869) confirmed his assertion that "*Aphis rosae*" feeds in winter on stored potatoes; but it has taken us about half a century to understand how to interpret his statement.

*rumicis* Linne, *Aphis.* This common black aphid is not infrequently recorded as collected from potato or related plants; but there is no recorded evidence that it thrives on these plants or establishes more than feeble unstable colonies there. That its favorite plants lie outside the *Solanaceae* is the verdict from both sides of the Atlantic. Davidson (1914), p. 118-141 observed the distribution of *Aphis rumicis* on plants grown in an open garden and recorded (p. 133) of the tomato "A few individuals generally distributed over these plants, but the aphids do not seem to be forming colonies." This was after the aphids had had more than a month's opportunity to establish themselves on the tomatoes. Borner and Janisch (1922) state that *Aphis euonymi* occurs in summer and early autumn on *Solanum nigrum,* but indicate it as "not injurious." Theobald (1922), says "The Common Black Fly or Collier, *Aphis rumicis* of Fabricius also occurs now and again on the bine, but does not flourish there and is apparently only a casual visitor."

*scabiosae* Schrank, *Aphis*

*scabiosae* (Schrank), *Macrosiphum.* As the authors who consider *scabiosae* Schrank to be an *Aphis* and those who consider it to be a *Macrosiphum* both report "*scabiosae* Schrank" from *Nicotiana,* the confusion cannot very well be settled at present, as far as the *Solanaceae* are concerned.

*silybi* Passerini, *Aphis.* Passerini (1863). What the species is does not seem to be established in current literature. Theobald (1922), p. 4 mentions finding it in Cornwall.

*solanella* Theobald, *Aphis.* Theobald (1914). Africa.

*solani* (Kaltenbach), *Macrosiphum.* Theobald (1922), p. 6 says in discussing that pink or green *Macrosiphum* migrating between *Rosa* and *Solanum* (and many other summer plants) which we generally know by

the name of *solanifolii*, "I feel sure that this is Kaltenbach's *Aphis solani*." If this can be established Ashmead's name given in 1882 will be one of a considerable number that should be discarded in favor of *Macrosiphum solani* Kaltenbach.

*solani* Kaltenbach, *"Myzus."* The *Aphis solani* of Kaltenbach has sometimes been interpreted as belonging to the genus *Myzus*. The general interpretation, however, is that it is a *Macrosiphum*. *"Myzus solani"* of authors probably often is a synonym of *Myzus persicae*.

*solani* Kittel, *Aphis*. This species dates back to 1827. What it may have been does not seem to be known.

*solani* (Thomas), *Rhopalosiphum*. The species Thomas described as *Megoura solani* with cornicles "excessively enlarged in the middle" was apparently not *Myzus persicae*. The figures drawn from the Thomas slide by Davis (1913) also indicate that this is not *Myzus persicae*. As no such species is known for the tomato, it seems probable that the specimens he took were accidently on that plant. The description of the "pupa" given by Thomas would much better apply to that of *Macrosiphum solanifolii* than that of *Myzus persicae*. The chances seem to be that Thomas collected some *Rhopalosiphum* alighted by chance on tomato and that his "pupae" were those of *Macrosiphum solanifolii*. However the *"solani* Thomas" of American authors since that time (except the Davis paper quoted) should be interpreted as *Myzus persicae*.

*solanifolii* (Ashmead), *Macrosiphum*. See p. 10 to 15 of this bulletin. See also *Macrosiphum cucurbitae* and *Macrosiphum solani*.

*solanina* Passerini, *Aphis*. See comments under *Aphis abbreviata* and *Aphis frangulae*.

*solanophilus* Blanchard, *Aphis*. Blanchard (1923), p. 45. "This species comes close to *solanella* Theobald but may be separated at once by absence of secondary tubercle on first abdominal segment as well as different abdominal dorsal markings." On *Solanum nodiflorum* Jacq. Palermo, Argentina.

*sonchi* (Linne), *Macrosiphum*. Theobald (1913), p. 55, lists this species for *Solanum tuberosum*. It could have only a chance connection with this plant.

*subterraneus* Del Guercio, *Lachnus*. See *Lachnus incertus*.

*tabaci* (Mordwilko), *Myzus*. Mordwilko (1914), p. 52 figures this species which so closely resembles *Myzus persicae* as to suggest identity.

*tabaci* (Pergande), *Macrosiphum*. This was recorded by Pergande (1898), p. 300 from tobacco, eggplant and tomato. It is a synonym of *Macrosiphum solanifolii*. The circumstance that the cornicles and antennae of the winged female are described as "black" indicates that the collection had these darker than is typical for potato. Such winged females are sometimes found late in the season on potato and even more frequently on other vegetation, in the north. Perhaps this may be still commoner in the south. To one used only to the paler individuals typical for the potato, these winged forms with darker members are

likely to be misleading. The near-black antennae and cornicles of this species, however, are never the jet black of *Macrosiphum rosae.*

*tuberosellae* Theobald, *Rhopalosiphum.* Theobald (1922), p. 3. This name was given to a small form of *Myzus persicae.*

*ulmariae* (Schrank), *Macrosiphum.* On *Hyoscyamus niger.* Wilson and Vickery (1918). Like *Macrosiphum solanifolii, Macrosiphum ulmariae* has been tangled up in literature with *Macrosiphum pisi* and it has often been considered a synonym of *Macrosiphum pisi.* However the foodplant data are against considering a *Spiraea* aphid to be the same as *Macrosiphum pisi. "Macrosiphum ulmariae"* Schrank of Theobald (1913), p. 137 has cornicles with reticulated tips, like those of *Macrosiphum solanifolii.* Further acquaintance with the *Spiraea* species may enable us to straighten out the status of this name.

*urticaria* Kaltenbach, *Aphis.* Buckton (British Aphides, vol. II), p. 51 states "Mr. Walker has taken the insect on the potato." When the life cycle of this species is known, its identity can doubtless be better established.

*xanthomelas* Koch, *Chaitophorus. Lycium europaeum.* Koch (1857), p. 2 "vielleicht zufallig dahin gekommen."

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* * * * * * * * * * *

The present conception of the intimate relation of phloem to virus diseases of plants gives added economic significance to the manner in which aphids feed. It is into the phloem of plants that the mouthparts of aphids penetrate.

"The piercing organ (of an aphid) resembles a flexible bristle and is readily bent in any direction. Its course in the plant tissues is associated with the search after nutritive cell sap, as is well illustrated by the richly branching stylet tracks found in the phloem. In cleared preparations of a piece of stem or leaf with aphids *in situ*, it can be seen passing through the epidermis into deeper tissues." J. Davidson, (1923) p. 30.....

This present bulletin has been prepared with especial reference to those aphids which, because they feed upon plants of the Nightshade Family, are potential carriers of certain virus diseases of such plants.

But the possibility of disease transference is not confined to members of the same plant family. One of the bulletins in the foregoing list of publications, (Elmer, 1925), records the experimental transmission of mosaic from certain plants of one family to certain plants in other families. Since the aphids feeding upon plants of the Nightshade Family are not exclusively confined to the potato and related plants, it is possible that they constitute even a greater menace than has been thought. Doctor Elmer's statement that "aphids.....transmitted the mosaic virus from infested cowpea and potato to cowpea plants" indicates such a menace by aphids as carriers of diseases between plants belonging to distinct families.

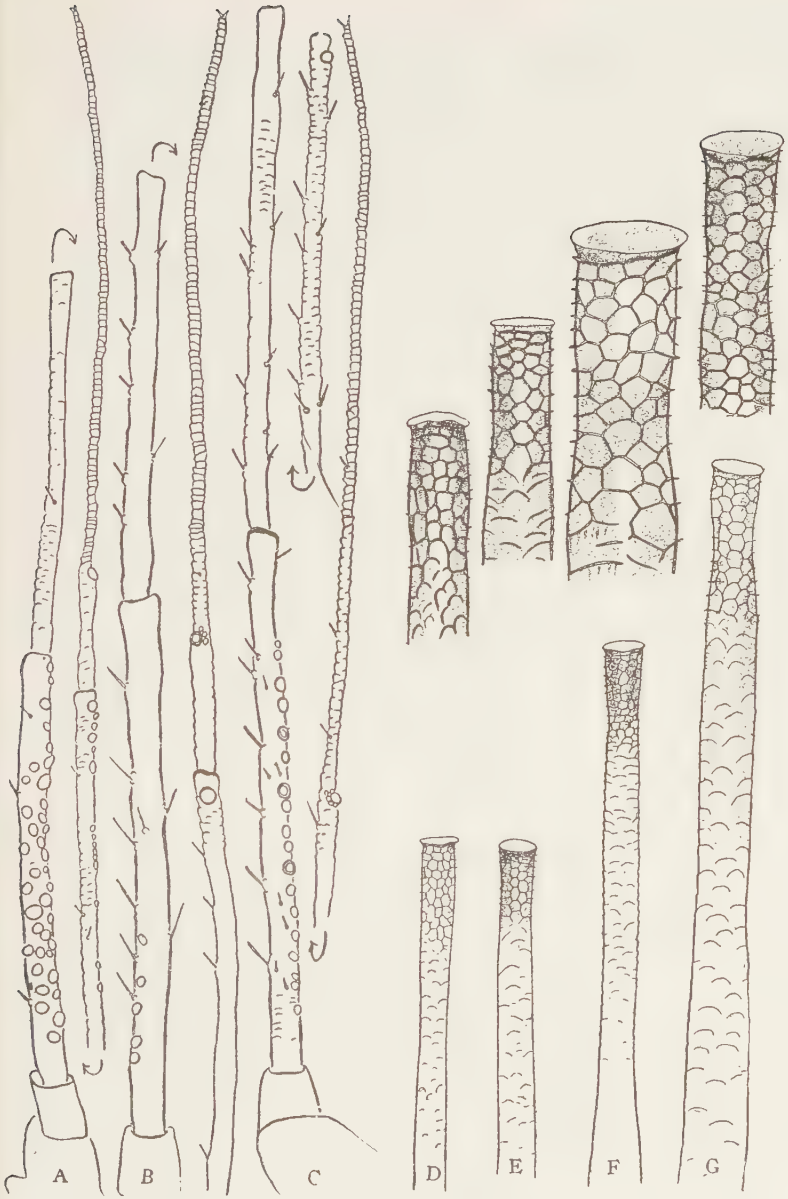


FIG. 2. *Macrosiphum solanifolii*, antennae and cornicles. A, winged male; B, wingless viviparous female; C, winged viviparous female; D, male; E, wingless oviparous female; F, winged viviparous female; pink variety; G, wingless viviparous female, green variety.

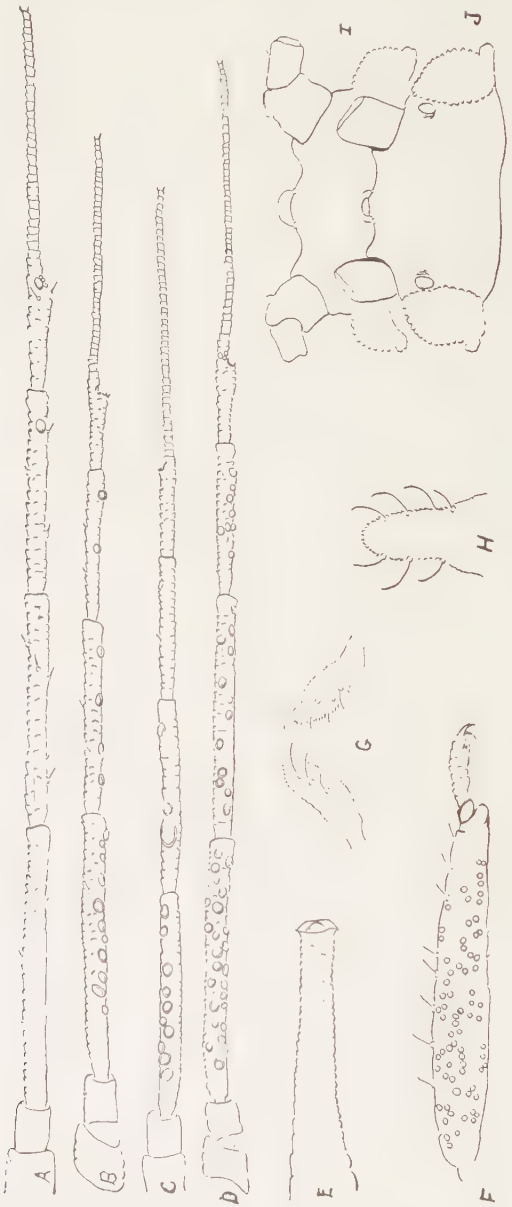


FIG. 3. Details of the buckthorn aphid *(Aphis abbreviata)*. A, antenna of wingless viviparous female; B and C, antennae of winged viviparous females; D, antenna of winged male; E, cornicle of wingless female; F, hind tibia of wingless oviparous female showing sensoria; G, cauda, lateral view showing caudal hairs, one with 3 and one with 4; H, cauda, dorsal view showing hairs as often found 3 on one side and 4 on the other; I, head of wingless female; J, head of winged female.

FIG. 4. *Macrosiphum solanifolii* on potato.

FIG. 5. Work of *Aphis abbreviata* on buckthorn. This insect migrates to potato and other vegetation for the summer.

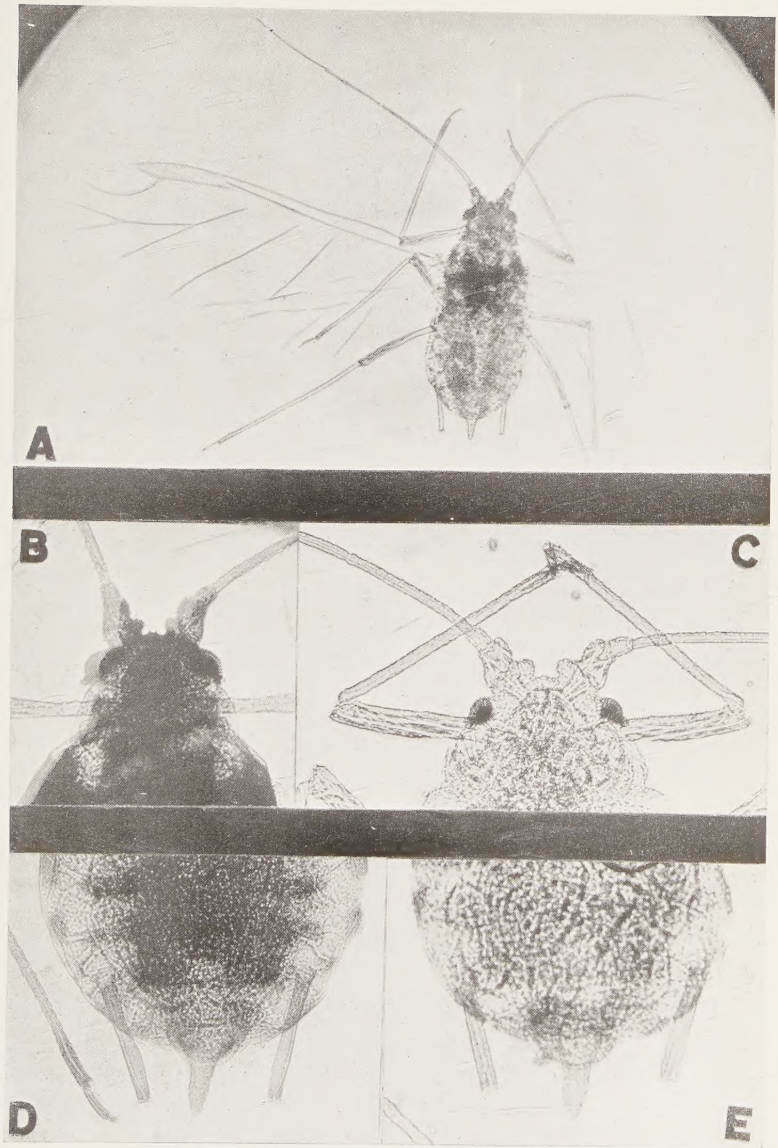


FIG. 6. *Myzus persicae*. A, summer winged female (126-21); B, head of summer winged female (28-19); C, head of wingless female (617-23); D, abdomen of summer winged female showing swollen cornicles (28-19); E, spring winged female, showing sraight cornicles (43-21).